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Subject: Coefficients of A/D Responsivity and the Conversion of the MODIS Digital Number to Pre-Amplified Voltages for the Infrared Bands

Ref: "Requirements for MODIS Testing Support Software", 151868, by SBRC, November 18, 1994, pg. 21.
"Equations for the DC Restore Algorithm Evaluated by Data from the Radiometric Math Model for the Photo-conductive Bands 31-36" PL3095-M00890 (#391), by G. Hyde, April 1, 1992.
"Equations for the DC Restore Algorithm Evaluated by Data from the Radiometric Math Model for the Photo-voltaic Bands 1-30" PL3095-M00832 (#388), by G. Hyde, March 31, 1992.
"ATBD for MODIS Level 1B Algorithm", by NASA/MCST, December 22, 1994, pg. 35.

The following are the current MCST algorithms for converting the MODIS digital number output of the analog to digital (A/D) converter into the pre-amplified voltages. These algorithms are essential to the master curve theory since a digital number by itself has no meaning without its respective applied gains and offsets.

The pre-amplified voltages will be determined in three modular steps. The first module determines the A/D converter coefficients based on on-orbit and/or pre-launch measurements. The second module converts the MODIS digital number output of the A/D converter into the voltage input of the A/D converter. The third module converts the voltage input of the A/D converter into the pre-amplified voltages. There is a distinct third modular stage for both the photovoltaic and the photoconductive bands due to their differing electronic configuration. Figure 1 outlines these modules with their respective input and output parameters.

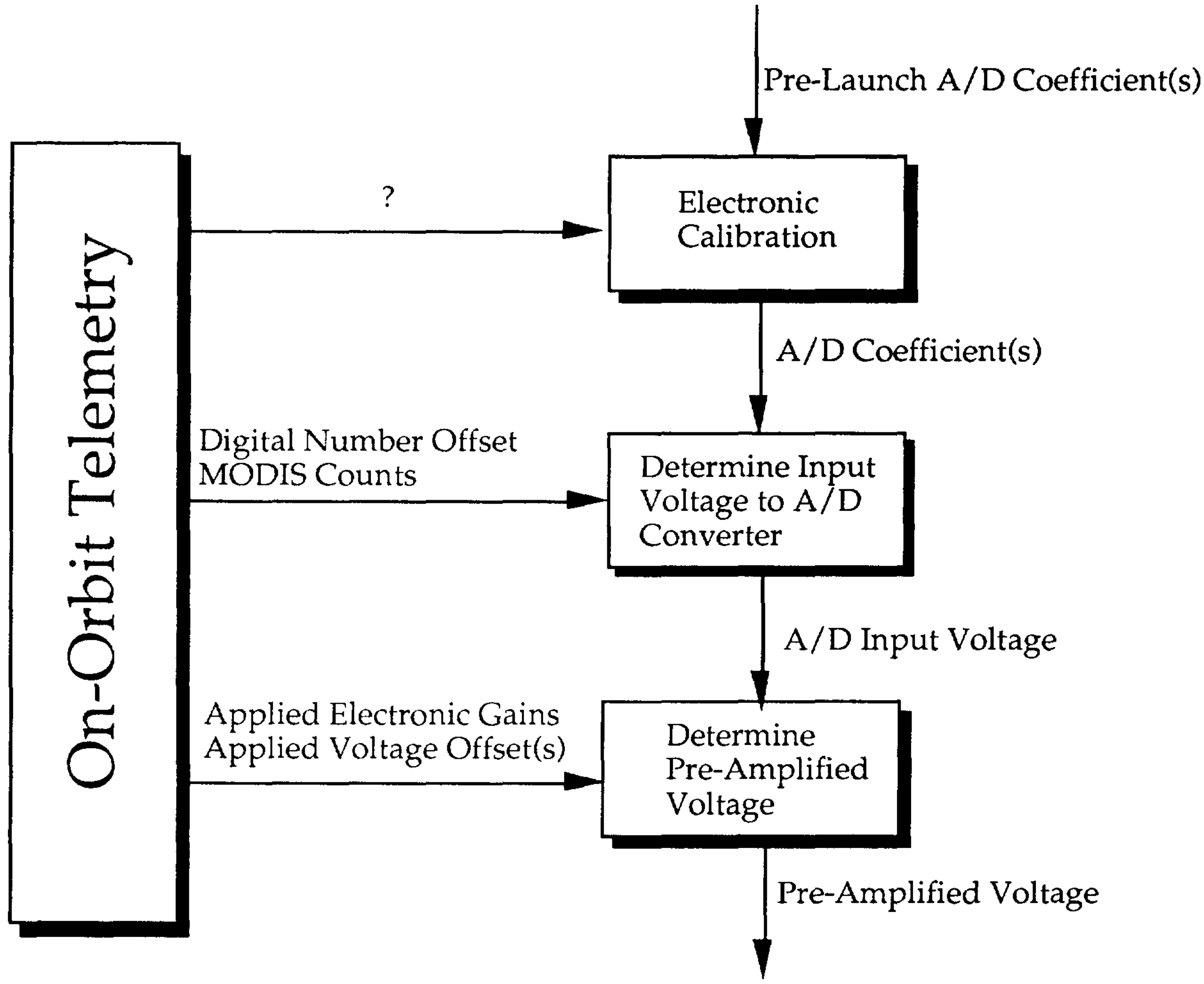

Figure 1. Outline of Pre-Amplied Voltage Determination Algorithm

Electronic Calibration

The on-orbit and pre-launch approaches to determining the coeffiecents of A/D responsivity are TBD for this memorandum.

Determine Input Voltage to A/D Converter

The functionality of the A/D output with respect to the input voltage will be analyzed to determine the best fit to use. The following are examples of a linear and a non-linear fit.

Linear Fit:

$$V_{A/D} = \frac{DN - DN_o}{R_{A/D}}$$

Quadratic Fit:

$$V_{A/D} = a(DN - DN_o)^2 + b(DN - DN_o)$$

or

$$V_{A/D} = \frac{-b + \sqrt{b^2 + 4a(DN - DN_o)}}{2a}$$

Determine Pre-Amplified Voltage: Photovoltaic Bands

To calibrate the photovoltaic bands, the pre-amplified voltage across the detector will be used, since it increases with detector irradiance.

Therefore:

$$V_{det} = \frac{V_{A/D}}{G_1 G_2 G_3 G_4} - V_{DC1}$$

Determine Pre-Amplified Voltage: Photoconductive Bands

To calibrate the photoconductive bands, the pre-amplified voltage across the load resistor will be used, since it increases with detector irradiance.

Therefore:

$$V_{det} = \frac{V_{A/D}}{G_1 G_2} - \frac{V_{DC2}}{G_1} - V_{DC1}$$

It is important to note that the actual value for V_{DC1} and V_{DC2} will be negative.